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THE NITROGENOUS METABOLISM OF BACILLUS ALKALESCENS

STUDIES IN BACTERIAL METABOLISM. LXIV

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Bacillus alkalescens is an organism of somewhat obscure origin and significance which was isolated from diarrheal feces by English observers during investigations of bacillary dysentery. Like the Schmitz bacillus, described previously,[1] the position of B. alkalescens in the group of intestinal bacteria is somewhat indeterminate, although there is on the whole less evidence that B. alkalescens is of material significance in the etiology of a dysenteric syndrome than is the case with the Schmitz bacillus. Culturally, B. alkalescens, as its name would suggest, is characterized by the production of basic substances as the result of its action on proteins. In this respect, it differs quantitatively from B. alkaligenes, however. The latter ferments no known carbohydrates, and in general its nitrogenous activity is similar to that of B. typhosus in so far as available quantitative methods indicate.[2] The nitrogenous metabolism of B. alkalescens in sugar-free mediums resembles more closely that of the Bacillus of Morgan.[3] The carbohydrate fermentation, however, is different in that the Morgan bacillus produces gas (H_2 and CO_2) as well as acid from the fermentation of glucose, whereas B. alkalescens produces acid only under parallel conditions. The organism, furthermore, ferments mannitol. The Morgan bacillus does not.

DISCUSSION

B. alkalescens, in conformity with its name, brings about a rather vigorous change in reaction toward the alkaline side of neutrality in plain, sugar-free gelatin. Not only is there a considerable deamination (ammonia formation) and a distinct reduction in amino nitrogen in the cultures after several days' incubation, but the reaction becomes decidedly alkaline as well. The increase in protein nitrogen, indicative

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[1] Kendall, Haner and Bly: Study LXIII, Jour. Infect. Dis., 1922, 30, p. 245.

[2] Kendall, Day & Walker: Jour. Am. Chem. Soc., 1913, 35, p. 1213.

[3] Ibid., p. 1225.

of the incorporation of the nitrogenous constituents of the medium into the bodies of the bacteria, is even more energetic in the glucose medium than the sugar-free medium. In the former, 10% of the nitrogen is thus converted; in the latter, about 13%. The same sparing action of utilizable carbohydrate for protein is clearly shown by a comparison of the respective changes in protein nitrogen and ammonia nitrogen in the plain and glucose mediums. In the former, nearly 4% of the nitrogen of the medium is liberated as free ammonia (intracellular deamination) during the period when 10% of the total nitrogen is added to the protein fraction. This is interpreted as profound utilization of protein for energy by the bacteria during the first week of the incubation of the culture. On the contrary, in a medium of exactly the same composition, containing 1% of glucose in addition to the nitrogenous ingredients, the protein nitrogen fraction increases 13%, suggesting, if not proving, a larger proliferation of bacteria with no apparent change in the ammonia content of the medium. The substitution of a carbohydrate

TABLE 1

BACILLUS ALKALESCENS

Mg. per 100 C c	Control	Day	Plain Broth	Glucose Broth
Total nitrogen	1.080	1	1.080	1.080
Protein nitrogen	0.778		0.822	0.778
Nonprotein nitrogen	0.302		0.258	0.302
Polypeptid nitrogen	0.210		0.161	0.211
Amino nitrogen	0.042		0.038	0.041
Ammonia nitrogen	0.050		0.059	0.050
Reaction	+0.80		+1.30	+3.90
Ph	7.2		7.0	5.3
Total nitrogen	1.080	4	1.080	1.080
Protein nitrogen	0.778		0.811	0.790
Nonprotein nitrogen	0.302		0.269	0.290
Polypeptid nitrogen	0.210		0.172	0.195
Amino nitrogen	0.042		0.035	0.048
Ammonia nitrogen	0.050		0.062	0.047
Reaction	+0.80		+0.80	+5.10
Ph	7.2		7.1	5.3
Total nitrogen	1.080	7	1.080	1.080
Protein nitrogen	0.778		0.879	0.913
Nonprotein nitrogen	0.302		0.201	0.167
Polypeptid nitrogen	0.210		0.098	0.070
Amino nitrogen	0.042		0.022	0.048
Ammonia nitrogen	0.050		0.081	0.049
Reaction	+0.80		—0.60	+5.30
Ph	7.2		8.5	5.0
Total nitrogen	1.080	10	1.080	1.080
Protein nitrogen	0.778		0.856	0.890
Nonprotein nitrogen	0.302		0.224	0.190
Polypeptid nitrogen	0.210		0.116	0.101
Amino nitrogen	0.042		0.020	0.041
Ammonia nitrogen	0.050		0.088	0.048
Reaction	+0.80		—2.40	+5.20
Ph	7.2		8.7	5.3

source of energy for the protein source of energy results in more luxuriant growth, with a great saving of the protein constituents of the culture.

The changes in reaction in glucose gelatin are as great, or even greater proportionately than those in the plain gelatin cultures, although of opposite sign. The general behavior of the organism known as B. alkalescens, therefore, is that of a parasite rather than that of a pathogenic microbe, in so far as the magnitude of the changes in the utilizable constituents of the mediums in which it may be grown can determine this point. This agrees in essence with the general consensus of opinion relative to its importance in the etiology of dysenteric infection. In this respect it would appear to stand in rather close resemblance to the Morgan bacillus.